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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/976,559	10/12/2001	Pradip Mitra	10919/25501	1434

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EXAMINER	
LEE, SHUN K	

ART UNIT	PAPER NUMBER
2878	

DATE MAILED: 07/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/976,559	MITRA, PRADIP	
	Examiner	Art Unit	
	Shun Lee	2878	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 May 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 October 2001 and 10 May 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings were received on 10 May 2004. These drawings are acceptable.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 28, 29, 31, 32, 41, 42, and 44-46 are rejected under 35 U.S.C. 102(b) as being anticipated by Cockrum *et al.* (US 4,956,304).

In regard to claim **41**, Cockrum *et al.* disclose (Figs. 1 and 4A-4K) a radiation detector comprising:

(a) a substrate (is inherent in an epitaxially grown radiation absorption layer 12; column 2, line 68 to column 3, line 4);

(b) a radiation absorption layer (12) above the substrate;

(c) a passivation layer (18) above the radiation absorption layer (12);

(d) a doped region (14) in the radiation absorption layer (12) and inherent in a thermal diffusion process (column 6, lines 15-62) is an extension of the doped region through the passivation layer (18); and

(e) an electrical contact (20) to provide electrical contact to the doped region (14).

In regard to claim **42** which is dependent on claim 41, Cockrum *et al.* also disclose (column 2, line 68 to column 3, line 4) that the absorption layer (12) includes HgCdTe.

In regard to claim **44** which is dependent on claim 41, Cockrum *et al.* also disclose (column 6, lines 56-62) that a dopant of the doped region is p-type.

In regard to claim **45** which is dependent on claim 41, Cockrum *et al.* also disclose (column 6, lines 56-62) that a dopant of the doped region is arsenic.

In regard to claim **46** which is dependent on claim 41, Cockrum *et al.* also disclose (column 2, line 68 to column 3, line 4) that the radiation absorption layer (12) is adapted to detect infrared radiation.

In regard to claims **28**, **29**, **31**, and **32**, Cockrum *et al.* is applied as in claims 41, 42, 44, and 45 above. Cockrum *et al.* also disclose (column 6, lines 15-62) forming a patterned doping layer (30 in Figs. 4E and 4F) above the passivation layer (26 in Figs. 4C-44E) and driving (*i.e.*, thermally diffusing) dopant from the patterned doping layer (30 in Figs. 4E and 4F) into the radiation absorption layer (12 in Fig. 4F) to form a doped region (14a or 14b in Figs. 4G-4K).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 2, 4, 5, 14, 15, and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Rosbeck *et al.* (US 4,961,098).

In regard to claims **1**, **2**, **4**, and **5**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks forming a wider bandgap layer between the radiation absorption layer and the passivation layer. However, compositional grading is well known in the art. For example, Rosbeck *et al.* teach (column 3, line 54 to column 4, line 4) that compositional grading (*i.e.*, a plurality of layers wherein bandgap for each layer changes) provides the advantage of reduced leakage current and increased diode impedance as compared with a constant bandgap layer. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to compositional grade the absorption layer (12) in the method of Cockrum *et al.* by forming a wider bandgap layer between the radiation absorption layer and the passivation layer, in order to reduce leakage current and increase diode impedance.

In regard to claims **14**, **15**, and **17-19**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, 5, and 46 above.

6. Claims 30, 33, 35-40, 43, 47, and 49-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Mitra (US 5,998,235).

In regard to claim **30** (which is dependent on claim 28) and claim **43** (which is dependent on claim 41), the method and detector of Cockrum *et al.* lacks that the absorption layer includes $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$. Mitra teaches (column 3, line 54 to

column 4, line 10) that an absorption layer comprising $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ have a infrared response equivalent to HgCdTe but with the advantage of reducing defects. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to provide $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ for the absorption layer (12) in the method and detector of Cockrum *et al.*, in order to reduce defects.

In regard to claims **33**, **35-37**, **39**, and **40**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks that the absorption layer and the passivation layer are formed in situ by alternating layers of a first material (*i.e.*, HgTe) and a second material which is $Cd_{1-y}Zn_yTe$, where y (*e.g.*, y=0.056) is selected to provide a target lattice constant, the composition of the absorption layer and the passivation layer being determined by the relative thicknesses of the layers of the first and second materials and, after deposition of the layers of first and second materials, annealing the first and second materials to produce an alloy of the first and second materials. Mitra teaches (column 3, line 54 to column 4, line 16) that a layer formed from annealing alternating HgTe and $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ layers have the advantage reduced defects within the layer. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to anneal alternating HgTe and $Hg_{1-x}(Cd_{0.944}Zn_{0.056})_xTe$ layers to form the absorption layer (12) and the passivation layer (18) in the method of Cockrum *et al.*, in order to reduce defects.

In regard to claim **47**, **49-51**, **53**, and **54**, Cockrum *et al.* is applied as in claims 33, 35-37, 39, and 40 above.

In regard to claim **38** (which is dependent on claim 33) and claim **52** (which is dependent on claim 47), Mitra is applied as in claims 30 and 43 above.

7. Claims 3 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Rosbeck *et al.* (US 4,961,098) as applied to claims 1 and 14 above, and further in view of Mitra (US 5,998,235).

In regard to claim **3** (which is dependent on claim 1) and claim **16** (which is dependent on claim 14), Mitra is applied as in claims 30 and 43 above.

8. Claims 6, 8-13, 20, and 22-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Rosbeck *et al.* (US 4,961,098) and Mitra (US 5,998,235).

In regard to claims **6**, **8-10**, **12**, and **13**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, and 5 above and Mitra is applied as in claims 33, 35-37, 39, and 40 above.

In regard to claims **20**, **22-24**, **26**, and **27**, Cockrum *et al.* in view of Rosbeck *et al.* and Mitra is applied as in claims 6, 8-10, 12, and 13 above.

In regard to claim **11** (which is dependent on claim 6) and claim **25** (which is dependent on claim 20), Mitra is applied as in claims 30 and 43 above.

9. Claims 33, 34, 37, 39, 40, 47, 48, 51, 53, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Irvine *et al.* (US 4,566,918).

In regard to claims **33**, **34**, **37**, **39**, and **40**, Cockrum *et al.* is applied as in claims 28, 29, 31, and 32 above. The method of Cockrum *et al.* lacks that the absorption layer

and the passivation layer are formed in situ by alternating layers of a first material (*i.e.*, HgTe) and a second material (*i.e.*, CdTe), the composition of the absorption layer and the passivation layer being determined by the relative thicknesses of the layers of the first and second materials and, after deposition of the layers of first and second materials, annealing the first and second materials to produce an alloy of the first and second materials. Irvine *et al.* teach (column 2, lines 50-59; column 3, lines 34-44) that a layer formed from annealing alternating HgTe and CdTe layers have the advantage controlling the lateral uniformity of x. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to anneal alternating HgTe and CdTe layers to form the absorption layer (12) and the passivation layer (18) in the method of Cockrum *et al.*, in order to control the lateral uniformity of x.

In regard to claim **47**, **48**, **51**, **53**, and **54**, Cockrum *et al.* is applied as in claims 33, 34, 37, 39, and 40 above.

10. Claims 6, 7, 10, 12, 13, 20, 21, 24, 26, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cockrum *et al.* (US 4,956,304) in view of Rosbeck *et al.* (US 4,961,098) and Irvine *et al.* (US 4,566,918).

In regard to claims **6**, **7**, **10**, **12**, and **13**, Cockrum *et al.* in view of Rosbeck *et al.* is applied as in claims 1, 2, 4, and 5 above and Irvine *et al.* is applied as in claims 33, 34, 37, 39, and 40 above.

In regard to claims **20**, **21**, **24**, **26**, and **27**, Cockrum *et al.* in view of Rosbeck *et al.* and Irvine *et al.* is applied as in claims 6, 7, 10, 12, and 13 above.

Response to Arguments

11. Applicant's arguments filed 10 May 2004 have been fully considered but they are not persuasive.

Applicant argues (pg. 16-24 of remarks filed 10 May 2004) that Cockrum *et al.* does not disclose forming a patterned doping layer above the passivation layer and driving dopant from the patterned doping layer into the radiation absorption layer to form a doped region. Examiner respectfully disagrees. Cockrum *et al.* state (column 6, lines 15-62) "Referring to FIGS. 4a-4k there is illustrated another method of the invention which forms by a diffusion process p-n diode junctions which lie under the passivation layer 18. Steps 4a-4c are substantially the same as steps 3a-3c above. In step 4d portions of the passivation layer 18 are selectively removed through the openings within mask layer 26. This step of selectively removing may be accomplished by the aforementioned wet chemical etch such that the underlying p-type substrate is not converted to n-type. In step 4e a relatively thin source layer 30 of a suitable n-type dopant is deposited over the surfaces of the photoresist layer 26 and the surfaces exposed within the openings. For example, the source layer 30 may comprise indium and may have a thickness of approximately 100 angstroms. FIG. 4f shows the structure after the photoresist layer is removed, thereby rejecting the overlying source layer 30 except where it contacts the layer 12 and the exposed surfaces of the passivation layer 18. A heating process is thereafter performed which diffuses indium from the source layer 30 into the p-type layer 12, thereby converting the p-type material and forming the diffused n-type regions 14a and 14b. As can be seen in FIG. 4g, diffused the n-type

regions 14a and 14b extend laterally outwards and the resultant p-n junctions underlie the passivation layer 18. FIG. 4h shows a second photomask layer 26a which is applied by a conventional method such that it overlies the passivation layer 18. The steps illustrated in FIGS. 4i through 4k are substantially the same as FIGS. 3e through 3g, described above, wherein contact metallization and ground metallization are provided with the second and third mask layers. As described above, the mask layer 26 is removed in step 4f before the step of diffusing is accomplished. This is preferable in that the heat applied during the diffusion process may cause a polymerization of the mask layer 26, making the subsequent removal of the layer 26 difficult to accomplish. It can be appreciated that, depending on the type of material which comprises the mask layer 26, the diffusion step may be accomplished before the removal of the mask layer 26". Thus Cockrum *et al.* teach (column 6, lines 15-62) forming a patterned doping layer (30 in Figs. 4E and 4F) above the passivation layer (18 in Figs. 4B-44K) and driving (*i.e.*, thermally diffusing) dopant from the patterned doping layer (30 in Figs. 4E and 4F) into the radiation absorption layer (12 in Fig. Figs. 4A-44K) to form a doped region (14a or 14b in Figs. 4G-4K).

Applicant also argues (pg. 16-24 of remarks filed 10 May 2004) that Cockrum *et al.* does not disclose a doped region extending through the passivation layer into the radiation absorption layer since diffusion 14 is formed after or during the process of exposing the surface of substrate 12 by etching passivation layer 18. Examiner respectfully disagrees. Cockrum *et al.* also disclose (column 2, line 67 to column 3, lines 21) that both the radiation absorption layer (12) and the passivation

layer (18) comprise $Hg_{1-x}Cd_xZnTe$. As discussed above, Cockrum *et al.* teach a thermal diffusion process wherein dopants from a patterned doping layer (30 in Figs. 4E and 4F) diffuse into $Hg_{1-x}Cd_xZnTe$. Thus it is clear from Fig. 4F that dopants from the patterned doping layer (30) thermal diffuses into both the $Hg_{1-x}Cd_xZnTe$ radiation absorption layer (12) and the $Hg_{1-x}Cd_xZnTe$ passivation layer (18). Therefore, Cockrum *et al.* disclose a doped region extending through the passivation layer into the radiation absorption layer.

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shun Lee whose telephone number is (571) 272-2439. The examiner can normally be reached on Monday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on (571) 272-2444. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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